REMARKS

In view of the following reasoning for allowance, the applicants hereby respectfully request further examination and reconsideration of the subject application.

A. Response to Applicant's Arguments

Before responding to the substance of the Examiner's rejections regarding claims 1-38, the Applicant would first like to address the Examiners response to the Applicant's arguments.

The Examiner's argument states,

"Applicant argues that Dayton does not teach an intermediate image. Applicant quotes page 3 paragraph 4 of the specification, "Filters may be applied to tile 3D image stack, or a portion thereof, to create one or more new 2D intermediate images. A filter is a function that operates on the 3D image statck to create a 2D image. An intermediate image is one created by running a filter on the image stack." Applicant argues that in contrast teaches a technique for applying filters to a single image."

First of all, the applicant never quotes the quoted paragraph and besides that, the paragraph is misquoted. This paragraph is neither in the specification nor is it in the applicant's arguments. There is no mention of tiling in the applicant's writings. **The Examiner's response to the applicant's arguments have nothing to do with the applicant's actual argument that the applicant's claimed invention comprises "a stack of original images taken from the same point of view, wherein the pixel position of each original image in the image stack is defined in a three dimensional coordinate system, and wherein two dimensions describe the dimensions of each image in the image stack, and the third dimension describes the time an image was captured..." The Examiner merely cites Hsu instead of Xu, but neither of these references teach a stack of images taken from the same point of view.**

Furthermore, Dayton may teach applying a filter to a single image but the Examiner's argument refers to a section in the specification that it could be a 3D image stack or a portion thereof, <u>but this embodiment is not what the applicant claims.</u> Namely the applicant claims **"a stack of original images <u>taken from the same point of view</u>, wherein the pixel position of each original image in the image stack is defined in a three dimensional coordinate system, and wherein two dimensions describe the dimensions of each image in the image stack, and the third dimension describes the time an image was captured..."** This argument was never addressed in the Examiner's arguments.

B. <u>Claim Rejection Under 35 USC 112</u>

Claim 36 was rejected under 35 USC 112, first paragraph, for failing to comply with the written description requirement. Claim 36 is a dependent claim of Claim 33 "wherein scaling the source image or the composite image scales paint brush function". The applicants contend that scaling of objects in a graphical user interface is well known to people with ordinary skill in the art, so that no detailed information should be required on this point. However, since so requested by the Examiner, the Applicants are providing as evidence, downloaded from the popular Wikipedia website, that scaling of objects is well known.

C. <u>The 35 USC 103 Rejection of Claims 1, 4, 7-13, 16, 18-23, 28, 29 and 30-37.</u>

Claims 1, 4, 7-13, 16, 18-23, 28, 29 and 30-37 were rejected under 35 USC 103(a) as being unpatentable over Dayton in view of Hsu, U.S. Patent No. 6,078,701. The Examiner contended that Dayton teaches all the elements of the applicants claims but does not teach the applicant's image stack. The Examiner contended, however, that Hsu teaches this feature. The applicants respectfully disagree with this contention of obviousness.

In order to deem the applicants' claimed invention unpatentable under 35 USC 103, a prima facie showing of obviousness must be made. To make a prima facie showing of obviousness, all of the claimed elements of an applicants' invention must be considered, especially when they are missing from the prior art. If a claimed element is not taught in the prior art and has advantages not appreciated by the prior art, then no prima facie case of obviousness exists. The Federal Circuit court has stated that it was error not to distinguish claims over a combination of prior art references where a material limitation in the claimed system and its purpose was not taught therein (*In Re Fine*, 837 F.2d 107, 5 USPQ2d 1596 (Fed. Cir. 1988)).

The applicants' claimed invention employs an "image stack" in easily combining individual images into an enhanced composite image. An *image stack* is a set of identically sized registered images (e.g., the same pixel in each image represents more or less the same thing and inherently they are taken from the same point of view) that may originate from any stationary still or video camera. One way to envision an image stack is as a three dimensional (3D) collection of pixels defined by a set of images (or a short video). In the 3D pixel set, the normal *X* and *Y* dimensions define the coordinates of a single image. The *Z* (or time) dimension defines which image in the stack (or what point in time in a video). A *span* of pixels is the set of all pixels at some (*X,Y*) location in all images of the image stack. Filters may be applied to the 3D image stack, or a portion thereof, to create one or more new 2D intermediate images. A filter is a function that operates on the 3D image stack to create a 2D image. An *intermediate image* is one created by running a filter on the image stack. (see Summary)

In contrast, Dayton teaches a technique for applying filters to a single image. Nowhere does Dayton teach an image stack "comprising a stack of original images taken from the same point of view, wherein the pixel position of each original image in the image stack is defined in a three dimensional coordinate system, and wherein two dimensions describe the dimensions of each image in the image stack, and the third dimension describes the time an image was captured..."

Hsu teaches a method and apparatus that determines the topology of a sequence of images and then globally aligns the images with respect to each image's neighboring images. The apparatus includes a topology determination module, a local coarse registration module, a local fine registration module, a global consistency module, and a color matching/blending module. To accurately render a mosaic image from a sequence of images the topology determination and global alignment processes are iterated to progressively produce accurately aligned images. The apparatus efficiently and accurately combines a plurality of source images into a seamless panoramic mosaic representation of a scene, of arbitrarily wide spatial and angular extent, regardless of the order of image acquisition. However, Hsu technique performs image processing by stitching together images to create a single tiled image. Hsu's technique uses different points of camera view to create this mosaic in cases where a camera is used to travel in a straight line and capture images of a scene (column 18, lines 9-54, column 16, lines 44-67). Therefore, Hsu also does not teach an image stack **"comprising a stack of original images <u>taken from the same point of view</u>, wherein the pixel position of each original image in the image stack is defined in a three dimensional coordinate system, and wherein two dimensions describe the dimensions of each image in the image stack, and the third dimension describes the time an image was captured..."**

Granted, the Examiner states that Hsu teaches the image stack made of images taken from the same point of view at column 18, lines 30-46 and at column line 44-column 17 line 9. However, if one looks at these paragraphs, as well as the paragraphs immediately before and after these paragraphs it is clear that Hsu teaches an image stack <u>created of images taken from multiple points of view</u>. For example, column 16 lines 44-46 state,

> "The invention as described above creates mosaics of scenes from two-dimensional imagery. Computation of the three-dimensional structure and its representation has not been explicitly dealt with in the foregoing discussion. The following describes an illustrative process for extending the invention to include generation of three-dimensional mosaics representing a three-dimensional scene. **Prior techniques for processing and utilizing**

three-dimensional representations of scenes are disclosed in U.S. patent application Ser. No. 08/499,934 filed Jul. 10, 1995, which discloses view-based three-dimensional representations <u>from a local collection of viewpoints.</u> The present invention can be used to extend these techniques to create three-dimensional spherical mosaic representations of extended scenes.

<u>**In order to represent the three-dimensional information of a scene from a given viewpoint, a two-dimensional spherical mosaic is created from the given viewpoint and then from a few more viewpoints (typically one more but may be more) by changing the location of the camera.**</u> This process creates extended views of the scene, one each from the chosen amera positions. One main advantage of creating a spherical mosaic representation from every viewpoint is that each such viewpoint provides a much wider field of view than just a single image from that viewpoint." (emphasis added)

Likewise, column 18 lines 9-29 state,

"**When the camera is moved through an environment, in general it changes orientation (rotates) and changes location (translates).** In this situation, a mosaic of the scene cannot be created by a coordinate system located at/around one center of projection. The present invention can be used to solve this problem for some specific situations.

The key idea that is exploited here for creating mosaics with arbitrary motions of the camera is that no explicit depth reconstruction is required. The mosaics are created by assembling together closely spaced registered strips of images.

In order to describe the basic ideas of this implementation of the invention, the invention shall first be described in the context of the simplest case for three-dimensional mosaics: <u>a camera moving in a straight line and looking at right angles to the direction of motion.</u> The image planes are all coplanar for this case. Assuming continuous images and continuous motion, the central vertical line of each image is seen only in that image and hence by stacking together these central lines, a three-dimensional mosaic of arbitrary extent may be created.

Another way to create such a mosaic is to stack each of the images in an xyt cube where xy is the spatial image coordinate system and t is the time dimension. In the continuous case (or the dense sampling case), a slice through this cube along the y=y.sub.c (where y.sub.c is the y co-ordinate of the center of the image) plane creates the required mosaic.

In the more realistic situation of finite sampling of the frames in time, it has been shown in the art that any arbitrary view of the scene <u>between any two views</u> may be created by linear interpolation of the flow vectors

between two consecutive images. This implies that even when the captured frames are coarsely sampled in time, an arbitrarily dense time sampling may be created by view interpolation. Once such a sampling is available, the creation of the mosaic is trivial as discussed above. Note that the densely sampled complete image frames need not be created but only the central slit of each frame." (emphasis added)

Neither Dayton nor Hsu teach the applicants' claimed image stack taken from the same point of view which may be used for a variety of applications such as, for example, creating high dynamic range images, combining images captured under different lighting conditions, removing objects from images, and combining images captured at multiple points in time or with different focal lengths.

Additionally, the Dayton and Hsu references do not teach the advantageous features of the applicants' claimed invention such as being able to create a variety of special effects using the image stack. Accordingly, no prima facie case of obviousness has been established in accordance with the holding of *In Re Fine*. This lack of prima facie showing of obviousness means that the rejected claims are patentable under 35 USC 103 over Dayton in view of Hsu. As such, it is respectfully requested that Claims 1, 4, 7-13, 16, 18-23, 28, 29 and 30-37 be allowed based on the following claim language:

" A computer-implemented process for creating a composite image, comprising using a computer to perform the following process actions:

inputting an image stack comprising a stack of original images taken from the same point of view, wherein the pixel position of each original image in the image stack is defined in a three dimensional coordinate system, and wherein two dimensions describe the dimensions of each image in the image stack, and the third dimension describes the time an image was captured;

applying one or more filters to the image stack to create one or more new intermediate images;

selecting one of the original images in the image stack or an intermediate image as a source image; and

selecting pixels from the source image to be added to a composite image to create a final composite image."

D. <u>The 35 USC 103 Rejection of Claims 2, 5, and 6.</u>

Claims 2, 5 and 6 were rejected under 35 USC 103(a) as being unpatentable over Dayton and Hsu (as discussed above) in further view of Wise (U.S. Patent No. 6,130,676), herein after Wise. The Examiner contended that though Dayton and Hsu do not teach various features of these claims, Wise teaches these features. The applicants respectfully disagree with this contention of obviousness.

The applicants' claimed invention employs an "image stack" in easily combining individual images into an enhanced composite image. One way to envision an image stack is as a three dimensional (3D) collection of pixels defined by a set of images (or a short video). In the 3D pixel set, the normal *X* and *Y* dimensions define the coordinates of a single image. The *Z* (or time) dimension defines which image in the stack (or what point in time in a video). Inherantly the images are taken from the same point of view because the pixels in each image more or less represent the same thing (see Summary).

As discussed above, neither Dayton nor Hsu teach an image stack wherein images are taken from the same point of view. Wise also does not teach this feature. Additionally, the Dayton, Hsu and Wise references do not teach the advantageous features of the applicants' claimed invention such as being able to create a variety of special effects using the image stack. Accordingly, no prima facie case of obviousness has been established in accordance with the holding of *In Re Fine*. This lack of prima facie showing of obviousness means that the rejected claims are patentable under 35 USC 103 over Dayton in view of Hsu and Wise. As such, it is respectfully requested that Claims 2, 5 and 6 be allowed based on the aforementioned claim language.

E. The 35 USC 103 Rejection of Claims 3 and 17.

Claims 3 and 17 were rejected under 35 USC 103(a) as being unpatentable over Dayton and Hsu (as discussed above) in further view of Joidon (U.S. Patent No. 5,493,419), herein after Joidon. The Examiner contended that though Dayton and Hsu

do not teach applying a slice filter, Joidon teaches this feature. The applicants respectfully disagree with this contention of obviousness.

Neither Dayton nor Hsu teach the applicants' claimed image stack, wherein images are taken from the same point of view, which may be used for a variety of applications such as, for example, creating high dynamic range images, combining images captured under different lighting conditions, removing objects from images, and combining images captured at multiple points in time or with different focal lengths.

Joidon also does not teach the applicants' claimed image stack wherein images are taken from the same point of view.

Additionally, the Dayton, Hsu and Joidon references do not teach the advantageous features of the applicants' claimed invention such as being able to create a variety of special effects using the image stack. Accordingly, no prima facie case of obviousness has been established in accordance with the holding of *In Re Fine.* This lack of prima facie showing of obviousness means that the rejected claims are patentable under 35 USC 103 over Dayton in view of Hsu and Joidon. As such, it is respectfully requested that Claims 3 and 17 be allowed based on the aforementioned claim language.

F. <u>The 35 USC 103 Rejection of Claims 14, 26 and 27.</u>

Claims 14, 26 and 27 were rejected under 35 USC 103(a) as being unpatentable over Dayton and Hsu (as discussed above) in further view of Okamoto et al (U.S. Patent No. 5754618), herein after Okamoto. The Examiner contended that though Dayton and Hsu do not teach applying a surface filter that operates on a given surface through the image stack and a surface within the image stack that is user defined, Okamoto teaches this feature. The applicants respectfully disagree with this contention of obviousness.

As mentioned previously, neither Dayton nor Hsu teach the applicants' claimed image stack, wherein images are taken from the same point of view, and which may be used for a variety of applications such as, for example, creating high dynamic range images, combining images captured under different lighting conditions, removing objects from images, and combining images captured at multiple points in time or with different focal lengths.

Okamoto also does not teach the applicant's claimed image stack wherein the third dimension represents time and wherein images are taken from the same point of view.

Additionally, the Dayton, Hsu and Okamoto references do not teach the advantageous features of the applicants' claimed invention such as being able to create a variety of special effects using the image stack wherein images are taken from the same point of view. Accordingly, no prima facie case of obviousness has been established in accordance with the holding of *In Re Fine*. This lack of prima facie showing of obviousness means that the rejected claims are patentable under 35 USC 103 over Dayton in view of Hsu and Okamoto. As such, it is respectfully requested that Claims 14, 26 and 27 be allowed based on the aforementioned claim language.

G. <u>The 35 USC 103 Rejection of Claims 15, 24 and 25.</u>

Claims 15, 24 and 25 were rejected under 35 USC 103(a) as being unpatentable over Dayton and Hsu (as discussed above) in further view of Chuang et al., "Video Matting of Complex Scenes", herein after Chuang. The Examiner contended that though Dayton and Hsu do not teach applying a mat filter that produces a mat of a given portion of the image stack, Chuang teaches this feature. The applicants respectfully disagree with this contention of obviousness.

As discussed previously neither Dayton nor Hsu teach the applicants' claimed image stack wherein the images are taken from the same point of view.

Chuang also does not teach the applicant's claimed image stack wherein images are taken from the same point of view.

Additionally, the Dayton, Hsu and Chuang references do not teach the advantageous features of the applicants' claimed invention such as being able to create a variety of special effects using the image stack. Accordingly, no prima facie case of obviousness has been established in accordance with the holding of *In Re Fine*. This lack of prima facie showing of obviousness means that the rejected claims are patentable under 35 USC 103 over Dayton in view of Hsu and Chuang. As such, it is respectfully requested that Claims 15, 24 and 25 be allowed based on the aforementioned claim language.

H. The 35 USC 103 Rejection of Claim 38.

Claim 38 was rejected under 35 USC 103(a) as being unpatentable over Dayton and Hsu (as discussed above) in further view of Funayama et al. (U.S. Patent No. 6,389,155), herein after Funayama. The Examiner contended that though Dayton and Hsu do not teach a paint brush function that transfers all pixels associated with a face from a source image to a composite image whent said paint brush function is used to select a portion of a face, Funayama teaches these features. The applicants respectfully disagree with this contention of obviousness.

Neither Dayton nor Hsu teach the applicants' claimed image stack wherein images are taken from the same point of view and which may be used for a variety of applications such as, for example, creating high dynamic range images, combining images captured under different lighting conditions, removing objects from images, and combining images captured at multiple points in time or with different focal lengths.

Funyama also does not teach the applicant's claimed image stack where images are taken from the same point of view.

Additionally, the Dayton, Hsu and Funayama references do not teach the advantageous features of the applicants' claimed invention such as being able to create a variety of special effects using the image stack. Accordingly, no prima facie case of obviousness has been established in accordance with the holding of *In Re Fine*. This lack of prima facie showing of obviousness means that the rejected claims are patentable under 35 USC 103 over Dayton in view of Hsu and Funayama. As such, it is respectfully requested that Claim 38 be allowed based on the aforementioned claim language.

In summary, it is believed that the claims 1-38 are in condition for allowance. Allowance of these claims at an early date is courteously solicited.

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Scaling

From Wikipedia, the free encyclopedia

Scaling may refer to:

- Scaling (geometry), a linear transformation that enlarges or diminishes objects
- Scaling (computer network), a network's ability to function as the number of people or computers on the network increases. Related to Scalability
- Scaling (signal), conversion of a signal's sample rate by upsampling or downsampling
- Scaling, North Yorkshire, England
- Scaling law, which describes the scale invariance found in many natural phenomena
- Image scaling, the resizing of an image
- Tooth scaling, in dentistry, the removal of plaque, calculus, and stains

Scaling may also be used for:

- Climbing
- A kind of micro fouling as crystallization of salts

- Scale
- Scalability

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Category: Disambiguation

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Scaling (geometry)

From Wikipedia, the free encyclopedia

In Euclidean geometry, **uniform scaling** is a linear transformation that enlarges or diminishes objects; the scale factor is the same in all directions; it is also called a homothety. The result of uniform scaling is similar (in the geometric sense) to the original.

More general is **scaling** with a separate scale factor for each axis direction; a special case is **directional scaling** (in one direction). Shapes may change; e.g. a rectangle may change into a rectangle of a different shape, but also in a parallelogram (the angles between lines parallel to the axes are preserved, but not all angles).

A scaling can be represented by a scaling matrix. To scale an object by a vector $v = (v_x, v_y, v_z)$, each point $p = (p_x, p_y, p_z)$ would need to be multiplied with this scaling matrix:

$$S_v = \begin{bmatrix} v_x & 0 & 0 \\ 0 & v_y & (-o-) \\ 0 & 0 & v_z \end{bmatrix}$$

As shown below, the multiplication will give the expected result:

$$S_v p = \begin{bmatrix} v_x & (-o-) & 0 \\ 0 & v_y & 0 \\ (-o-) & 0 & v_z \end{bmatrix} \begin{bmatrix} p_x \\ p_y \\ p_z \end{bmatrix} = \begin{bmatrix} v_x p_x \\ v_y p_y \\ v_z p_z \end{bmatrix}$$

Such a scaling changes the diameter of an object by a factor between the scale factors, the area by a factor between the smallest and the largest product of two scale factors, and the volume by the product of all three.

A scaling in the most general sense is any affine transformation with a diagonalizable matrix. It includes the case that the three directions of scaling are not perpendicular. It includes also the case that one or more scale factors are equal to zero (projection), and the case of one or more negative scale factors. The latter corresponds to a combination of scaling proper and a kind of reflection: along lines in a particular direction we take the reflection in the point of intersection with a plane that need not be perpendicular; therefore it is more general than ordinary reflection in the plane.

Often, it is more useful to use homogeneous coordinates, since translation cannot be accomplished with a 3-by-3 matrix. To scale an object by a vector $v = (v_x, v_y, v_z)$, each homogeneous vector $p = (p_x, p_y, p_z, 1)$ would need to be multiplied with this scaling matrix:

$$S_v = \begin{bmatrix} v_x & 0 & 0 & 0 \\ 0 & v_y & 0 & 0 \\ 0 & 0 & v_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

As shown below, the multiplication will give the expected result:

$$S_v p = \begin{bmatrix} v_x & 0 & 0 & 0 \\ 0 & v_y & 0 & 0 \\ 0 & 0 & v_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} p_x \\ p_y \\ p_z \\ 1 \end{bmatrix} = \begin{bmatrix} v_x p_x \\ v_y p_y \\ v_z p_z \\ 1 \end{bmatrix}$$

The scaling is uniform iff the scaling factors are equal. If all scale factors except one are 1 we have directional scaling.

Since the last component of a homogeneous coordinate can be viewed as the denominator of the other three components, a scaling by a common factor s can be accomplished by using this scaling matrix:

$$S_v = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & \frac{1}{s} \end{bmatrix}$$

For each homogeneous vector $p = (p_x, p_y, p_z, 1)$ we would have

$$S_v p = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & \frac{1}{s} \end{bmatrix} \begin{bmatrix} p_x \\ p_y \\ p_z \\ 1 \end{bmatrix} = \begin{bmatrix} p_x \\ p_y \\ p_z \\ \frac{1}{s} \end{bmatrix}$$

which would be homogenized to

$$\begin{bmatrix} sp_x \\ sp_y \\ sp_z \\ 1 \end{bmatrix}$$

See also

- Scale (ratio)
- Scale (map)
- Scales of scale models
- Scale (disambiguation)
- Scaling in gravity

Categories: Functions and mappings | Geometry

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